REMARKS

Claims 12-22 are pending in the Office Action. Although no claims have been amended with this Response, Applicant respectfully provides a complete claim listing above. Applicant also respectfully provides a translation of the Soviet Union reference herewith.

Applicant respectfully thanks the Examiner for indicating the allowable subject matter of claims 13, 20, and 21. The Examiner's rejections will now be respectfully addressed.

Rejections under 35 U.S.C. §103(a)

Claims 12, 14-19, and 22 has been rejected under 35 U.S.C. §103(a) as being obvious United States Patent No. 5,328,157 to Mantey ("Mantey" hereinafter) in view of Soviet Union Application No. 1,442,829 ("SU" hereinafter). Applicant respectfully traverses this rejection.

For an obviousness rejection to be proper, the Examiner must meet the burden of establishing that all elements of the invention are disclosed in the prior art and that the prior art relied upon, coupled with knowledge generally available in the art at the time of the invention, must contain some suggestion or incentive that would have motivated the skilled artisan to modify a reference or combined references. *In re Fine*, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988); *In Re Wilson*, 165 U.S.P.Q. 494, 496 (C.C.P.A. 1970); *Amgen v. Chugai Pharmaceuticals Co.*, 927 U.S.P.Q.2d, 1016, 1023 (Fed. Cir. 1996).

Applicant's claim 12 recites, *inter alia*:

"providing a clearance between said tuyere assembly and a refractory lining portion below said tuyere assembly; and monitoring said clearance by means of a displacement sensor."

Neither Mantey nor SU, taken individually or in combination, teach provision or monitoring of a clearance ***below*** a tuyere assembly. On the contrary, Mantey teaches provision of ***radial*** clearance around a vertically mounted bottom blowing tuyere assembly fixed at a bottom of a converter (see col. 7, ln. 37-39 and col. 8 ln. 48-50). Being that the vertically mounted bottom blowing tuyere assembly of Mantey is fixed to the bottom of the converter, and inherently passes through the refractory lining, there can be no provided clearance, or monitoring of said clearance, between the tuyere assembly and refractory lining portion ***below*** the tuyere assembly, as is recited in Applicant's claims.

SU does not remedy this deficiency of Mantey. In the Office Action, the Examiner alleges that SU teaches a displacement sensor for controlling and monitoring displacement of a tuyere. However, SU does not actually teach a controlling and monitoring of displacement of a "tuyere." On the contrary, SU teaches controlling and monitoring a moveable oxygen injection lance, which was improperly referred to as a "tuyere." This is clearly apparent from the enclosed translation of SU, which teaches the control device to be intended for a moveably mounted and actuated object such as an oxygen injection lance, as opposed to an immobile bottom blowing tuyere (please see page 3, right hand column, second and last paragraph; page 4, left hand column second paragraph; and page 4, right hand column, fourth paragraph of the SU translation). Oxygen lances are clearly different than tuyeres in that they are typically vertically moveable and inserted as controllers to measure depth of a molten metal bath and/or slag layer in a converter (Applicant respectfully refers the Examiner to United States Patent No. 3,505,062 to Woodcock for a better description of oxygen injection lances).

Applicant further and respectfully traverses the Examiner's allegation that that the monitoring of the bottom clearance recited in Applicant's claim 12 is obvious due to the monitoring of "tuyere" displacement (or oxygen lance displacement is it is) taught in SU. On the contrary, Applicant respectfully notes that once "tuyere" displacement has occurred due to refractory expansion, damage to the tuyere assembly and/or refractory lining can no longer be safely prevented (please see page 1 line9 to page 2 line 19 of Applicant's Specification). Therefore, monitoring and controlling tuyere displacement is

respectfully irrelevant to monitoring the clearance recited in Applicant's claims. Accordingly, such monitoring and controlling of tuyere displacement should not be used render Applicant's claims obvious.

Applicant also respectfully notes that there is no motivation to combine the inherently immobile bottom blowing tuyere of Mantey with the "tuyere" (or oxygen lance displacement is it is) motion controller of SU. As evidence of this lack of motivation, Applicant respectfully points out that a "tuyere" motion controller could not move/control an immobile tuyere, and thus, the motion controller of SU would be inoperable for its intended tuyere controlling purpose if combined with Mantey. Similarly, if the controller of SU was somehow strong enough to dislodge and move the immobile tuyere of Mantey, the bottom mounted tuyere would be broken away from the bottom of the converter, thus destroying the device taught in Mantey as it relates to its intended purpose.

Applicant lastly notes that Mantey does not teach or suggest a furnace at all. Thus, Applicant respectfully asserts that Mantey is not of analogous art with either Applicant's claims or SU. Accordingly, Mantey should not be modified, combined with SU, to teach Applicant's claims.

For at least the above reasons, Applicant respectfully submits that *prima facie* obviousness does not exist regarding claim 12, or claims 14-19 and 22 that depend therefrom, with respect to the proposed combination of Mantey and SU.

Conclusion

Applicant believes that all of the outstanding objections and rejections have been addressed herein and are now overcome. Entry and consideration hereof and issuance of a Notice of Allowance are respectfully requested.

Applicant hereby petitions for any extension of time under 37 C.F.R. 1.136(a) or 1.136(b) that may be necessary for entry and consideration of the present Reply.

If there are any charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130 maintained by Applicants' attorneys.

The Office is invited to contact applicant's attorneys at the below-listed telephone number concerning this Amendment or otherwise regarding the present application.

Respectfully submitted,

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Date: June 17, 2008

UNION OF SOVIET SOCIALIST REPUBLICS

(19) **SU** (11) **1123021 A**

3 (51) G 05 B 19/18

USSR STATE COMMITTEE FOR INVENTIONS AND DISCOVERIES

(stamp, illegible apart from № 13)

DESCRIPTION OF INVENTION
FOR AUTHORSHIP CERTIFICATE

(21) 3638125/24-24
(22) 26.08.83
(46) 07.11.84. Bulletin № 41
(72) M.A. Melts
(71) Ukrainian State Design Institute "Metallurg-avtomatika"
(53) 621.503.55 (088.8)
(56) 1. USSR Authorship Certificate № 452808, cl. G 05 B 19/18, 1973
2. USSR Authorship Certificate № 1007085, cl. G 05 B 19/18, 1981 (prior art).

(54)(57) 1. K-STAGE STOP OBJECT PROGRAMMABLE CONTROL DEVICE, comprising a displacement sensor with output connected to the input of a reversible counter, outputs of a (k+1) comparison unit connected via a logic unit to the second inputs of an executive unit, and outputs of k comparison units connected via a logic unit to second inputs of the executive unit, the input of the (k+1) comparison unit being connected to the direction output of the reversible counter, and the second input to the first output of the program input unit, *characterised* in that, with the aim of simplifying the device and improving its operating reliability, a commutator is introduced into it, and also an adder, with inputs connected to the first outputs of the commutator, and output to the first inputs of the k comparison units, the second inputs of which are connected via the commutator to the second outputs of the program input unit, the inverse output of the reversible counter being connected to the third input of the commutator, the controlling inputs of which are connected to the outputs of the (k+1) comparison unit, and the third input of the adder to a "1" busbar.

2. Device in accordance with claim 1, *characterised* in that the commutator contains two groups of multi-digit gates, the controlling inputs of the multi-digit gates of both groups are connected to the controlling inputs of the commutator, the outputs of the multi-digit gates are combined and connected to the first and second outputs of the commutator, and their information inputs to the corresponding commutator inputs.

The invention relates to the automation of production processes and may be used in various control systems for the displacement of an object, e.g. in control systems for the displacement of an oxygen tuyère in a converter, in machine tools with digital program control, and in robots.

There is a known pulse counting program control system, containing a pulse generator, a displacement sensor connected to a reversible counter, and via it to a comparing device, the second input of which is connected to the program input unit, an executive unit, and a logic unit connected to the comparing device, the displacement sensor, the pulse generator, the program input unit, the pulse counter, and through it to an executive unit, to which the comparing device is connected [1].

The drawbacks of such a system are the complex work algorithm, the impossibility of automatically returning the object to the permissible stop zone in the event of a run beyond this zone, and the impossibility of correcting the task during the displacement of the object.

The device closest in its technical nature to the proposed one is a pulse

counting device for the program control of a k-staged stop object, containing 2k reversible counters and 2k comparison units, the outputs of which are connected via a logic unit to an executive unit, the first inputs are combined and connected to the output of the program input unit, the second inputs are connected to the outputs of the reversible counters, the counting inputs of which are combined and connected to the output of the displacement sensor, series-wired pulse generator, pulse counter and a reversible counter initial state setting unit [2].

Drawbacks of the known device are the relative complexity of its circuitry, also its inadequate reliability, and also the impossibility of changing the value of the control zones.

The aim of the invention is to simplify the device, make it more reliable in its operation and to make it more functionally versatile.

This aim is achieved by making the following alterations to a displacement sensor with output connected to the input of a reversible counter, outputs of the (k+1) comparison unit connected via a logic unit to the second inputs of an executive unit, and outputs of k comparison units connected via a logic unit to second inputs of the executive unit, the input of the (k+1) comparison unit is connected to the direction output of the reversible counter, and the second input to the first output of the program input unit: a commutator is introduced into it, and also an adder, with inputs connected to the first outputs of the commutator, and output to the first inputs of the k comparison units, the second inputs of which are connected via the commutator to the second outputs of the program input unit, the inverse output of the reversible counter being connected to the third input of the commutator, the controlling inputs of which are connected to the outputs of the (k+1+ comparison unit, and the third input of the adder being connected to a "1" busbar.

Furthermore, the commutator contains two groups of multi-digit gates, the controlling inputs of the multi-digit gates of both groups being connected to the controlling inputs of the commutator; the outputs of the multi-digit gates are combined and connected to the first and second outputs of the commutator, and their information inputs are connected to the corresponding inputs of the commutator.

Fig. 1 shows the structural layout of the device; Fig. 2 shows the relative disposition of the control command action zones of the device's executive unit; Fig. 3 shows the commutator circuit; and Fig. 4 shows the program input unit.

The program control device for an object with k-staged stop comprises comparison units 1_1, ..., 1_k and 1_{k+1}, adder 2, commutator 3, program input unit 4, reversible counter 5, displacement sensor 6, logic unit 7, executive unit 8 and digit "1" busbar 9. Logic unit 7 consists of OR gates 10_1, 10_2, ..., 10_{k-1} and AND gates 11_1, 11_2, ..., 11_{k-1}.

In the program control device for the k-staged stop object, the first inputs of comparison units 1_1, 1_2, ..., 1_k are combined and connected to the output of adder 2, the first and second inputs of which are connected to the first and second outputs respectively of commutator 3, the information inputs of which are connected to the outputs of program input unit 4 and the outputs of reversible counter 5 respectively. The output of displacement sensor 6 is connected to the counting input of reversible counter 5, the first output of which is connected to the first input of comparison unit 1_{k+1}, the second input of which is connected to the first output of program input unit 4, while the first and second outputs are connected to the first and second controlling inputs of commutator 3. The outputs of logic unit 7 are connected to the inputs of executive unit 8, the first and second controlling inputs of which are connected to the first and second outputs respectively of comparison unit 1_{k+1}.

Commutator 3 consists of multi-digit gates 12_1-12_k, 13_1-13_k and 14-17. Program input unit 4 consists of digital sensors 18, 19_1-19_{2k} and inverter unit 20.

Each of the comparison units 1_1, 1_2, ..., 1_k consists of a known comparing device with the signal "1" present at its first "More" input, if the code of a number greater than the code of the number present at its second input is present at its first input. If the relation between the

numbers is the opposite of that indicated, the signal "1" is present not at the first, but at the second "Less" output. If the numbers are equal, the signal "1" is present at the third output "Same".

Adder 2 consists of any of the known combination-type binary adders having two inputs for each digit and three inputs for the first digit. Adder 2 is intended for calculating the modulus of the difference between code T and code H_o.

It follows from the operation of the commutator that in the case in which $T > H_o$, the code H_{inv} (the inverse code obtained by the inversion of each digit of code H_o separately) goes to the second input of adder 2, and the code T goes to its first input.

In this case, the following is true for binary codes:

$C = T + H_o + 1 = T - H_o = (T - H_o)$

In the case in which $T < H_o$, the code T goes to the first input of the adder, and the code H_o goes to its second input, so in this case we have

$C = T_{inv} + H_o + 1 = H_o - T = (T - H_o)$.

When the signal "1" is present at the first controlling input of commutator 3, information coming to it via the odd inputs is contained at the outputs. But if the "1" signal is present at the second controlling input of commutator 3, information from its even inputs goes to its outputs. Commutator 3 is of a known design, consisting, for example, of two rows of multi-digit gates.

Program input unit 4 is intended for setting the stop point with coordinate H_o and for setting the distances $A_1, \ldots, A_k$ and $B_1, \ldots, B_k$ from the stop point H_o to the boundaries of the control zones (each control zone has its own speed $V_1\uparrow, \ldots, V_k\uparrow, V_1\downarrow, \ldots, V_k\downarrow$). It is possible to change the binary codes $H_o, A_1, \ldots, A_k, B_1, \ldots, B_k$ simultaneously or independently of each other. In this case the following condition must be observed:

$$A_p > A_{p-1} (B_p > B_{p-1}).$$

Reversible counter 5 consists of a binary reversible counter, at the first output of which the direct code T for the "current" position of the object is present, the inverse code T being present at the second output.

The logic unit 7 is in the form of a combined circuit consisting of OR and AND gates intended for forming a "1" signal at one of its outputs corresponding to a certain speed value. Since the object cannot physically be present in several control zones at the same time (Fig. 2), the "1" signal can only go to one output of logic unit 7, depending on the control zone in which the object is located at the time in question. If the object is located higher than the set stop point H_o, but not by more than $H_o + A_1$, or lower than point H_o, but not by more than $H_o + B_1$, i.e. in the "insensitivity" zone, the signal "1" will not be present at any output of logic unit 7.

Executive unit 8 may consist, for example, of a relay circuit intended to form a command for the displacement of the object at a certain speed in the appropriate direction in the case in which a "1" signal goes to one of the k inputs of executive unit 8 from the logic unit 7 side (which determines the speed rating), and at the same time, a "1" signal goes to the k+1 or k+2 input of executive unit 8 from the comparison unit 1_{k+1} side (which determines the speed direction). If the information on the required speed rating does not go to executive unit 8 (the object being in the "insensitivity" zone), or information on the speed direction ($T = H_o$) does not go to the executive unit, the movement command is not given by the executive unit (the drive is switched off).

The device operates in the following manner.

During the displacement of the object, pulses go from displacement sensor 6 to the input of reversible counter 5, at the output of which the direct and inverse codes of the object coordinate (T and T_{inv}) are present.

As a result of the comparison of code T with code H_o for setting the stop point, a "1" signal is formed at one of the outputs of unit 1_{k+1}, which determines the direction of displacement of the object towards point H_o.

Depending on the inequality sign between the set and current positions of the object, the respective codes T_{inv} and H_o or T and $H_{o.inv}$ go from the outputs of reversible counter 5 and program input unit 4 via commutator 3 to the first and second inputs of adder 2.

The code $C = (T - H_o)$, i.e. the code for the value of the distance between the object and the set point for its stop (discrepancy value), is present at the output of adder 2.

Codes for the distances between the stop point H_o and the corresponding boundaries of the control zone go from the outputs of program input unit 4 via commutator 3 to the second inputs of comparison units $1_1, \ldots, 1_k$. In the case, for example, of vertical displacement of the object, codes for the distances between the set point H_o (Fig. 2) and points A_p or B_p, located above or below point H_o respectively, go to the second inputs of comparison units $1_1, \ldots, 1_k$, depending on the sign of the relation between codes T and H_o.

Depending on the location of the object in relation to the set stop point H_o, a "1" signal may be present either only at the first output of comparison unit 1_k, which is characteristic for the case in which $C > A_k(B_k)$, or simultaneously at the second and third outputs of comparison unit 1_p and the first output of comparison unit 1_{p-1} which is characteristic for the case in which $A_{p-1}(B_{p-1}) < C \geq A_p(B_p)$.

If the object (Fig. 2) is higher than the point with the coordinate $H_o + A_k$, because in this case $T > H_o$, then $C = (T - H_o) = T - H_o$, but since $T > H_o + A_k$, then $T - H_o > A_k$, i.e. $C > A_k$.

In this case, since $T > H_o$, the command "Lower" goes from the first output of comparison unit 1_{k+1} to the input of executive unit 8, and the signal V_k goes from the first output of comparison unit 1_k to executive unit 8 via logic unit 7. As a result, the object is lowered at speed V_k. At the moment when the object approaches the point with the coordinate $H_o + A_k$, the "1" signal disappears from the first output of comparison unit 1_k and appears at its second output ($C = A_k$).

Since now $C > A_{k-1}$, a "1" signal is also present at the first output of comparison unit 1_{k-1}.

As a result, the signal V_{k-1} goes from the output of AND gate 11_{k-1} to the input of executive unit 8, i.e. the lowering continues, but now at speed V_{k-1}. The transition to other speeds when the object enters other control zones takes place similarly. When the object approaches the point with the coordinate $H_o + A_1$, the "1" signal at the first output of comparison unit 1_1 disappears (i.e. signal V_1 is taken off). Since no other signals will now come to executive unit 8 from the outputs of logic unit 7, the electric drive is switched off, and the object begins to move by inertia in the insensitivity zone, approaches point H_o (distance A_1, the length of the inertia run, is determined in advance, and depends on various technical factors: time lag in the drive, the weight of the object and the speed rating V_1).

If the object is lower than the point with the coordinate $H_o + B_1$, control of the change in speed takes place similarly, but a "Raise" signal now appears at the third output of comparison unit 1_{k+1}; ($T < H_o$), $C = (T - H_o) = H_o - T$, and distances B are used instead of distances A (In Fig. 2, they are shown below point $\underline{H_o}$).

When the object rises, the lower boundary of the insensitivity zone (stop zone) corresponds to the point with the coordinates $H_o - B_1$.

Thus, when $T \neq H_o$ and the object is not located in the insensitivity zone, information on the rating and direction of the required speed of displacement of the object goes to the inputs of executive unit 8.

The proposed device has a simple working algorithm. Since, apart from the reversible counter, all the units represent combination circuits, the proposed device is highly reliable, and due to the use of a smaller number of reversible counters and comparison units, it is more reliable than the known device. The use of the proposed device makes it possible not only to reverse the displacement of the object (if it should happen to run beyond the limits of the stop zone) and to change the coordinate of the set stop point both when the objects is stationary and when it is mobile, but also to change the size of the control zones for the stationary or moving object, i.e. the program can be completely changed at any time.

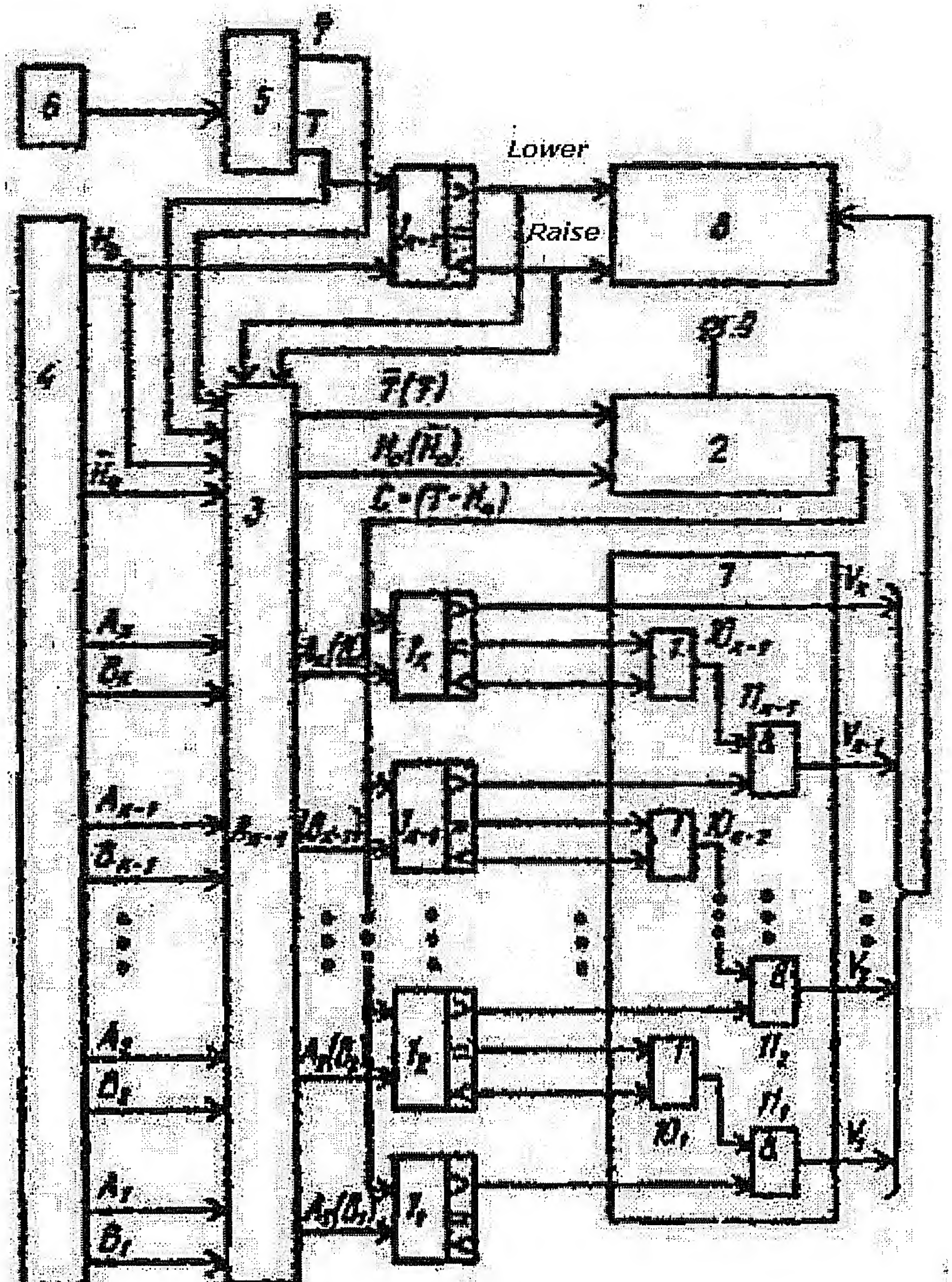


Fig. 1

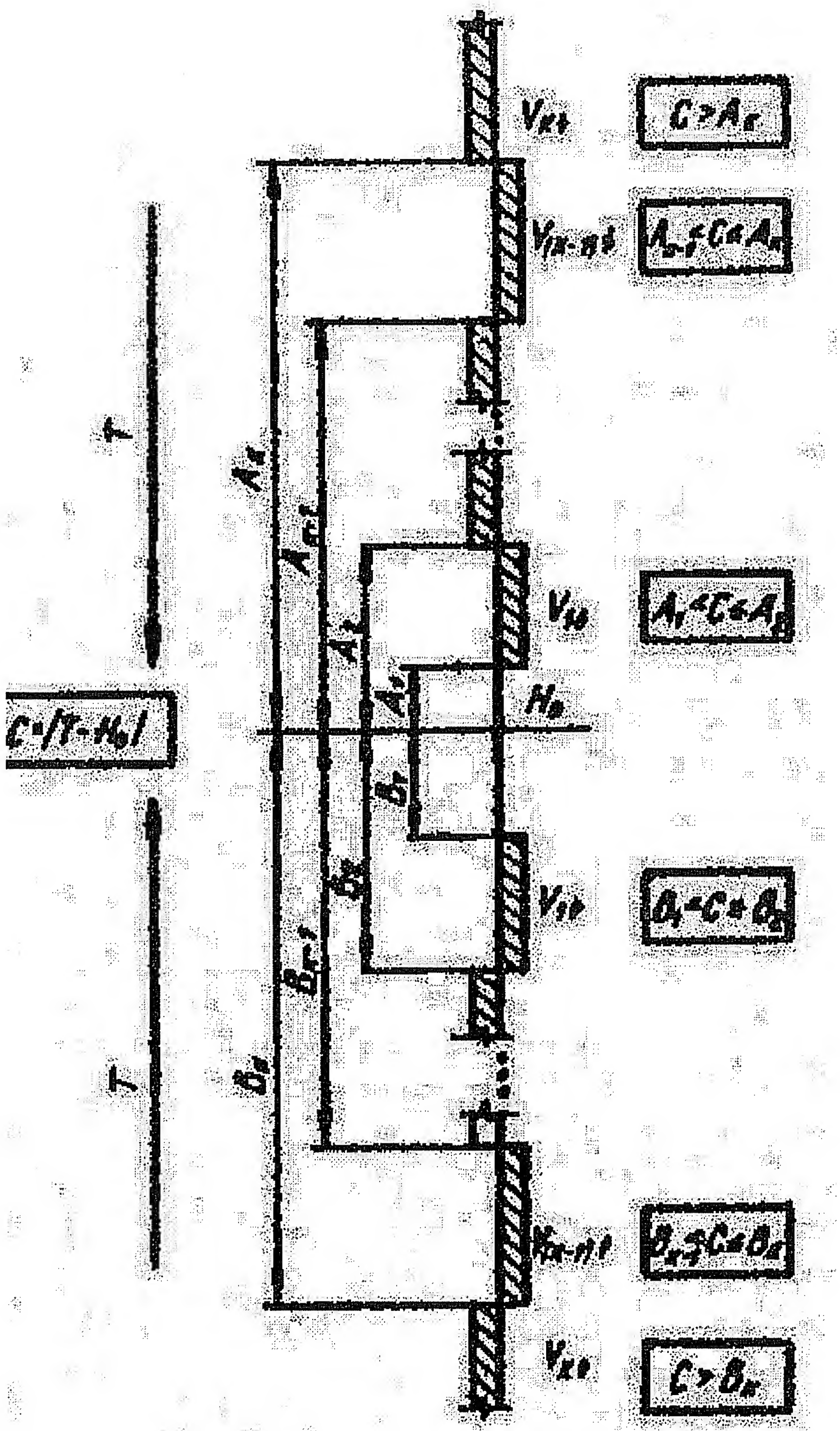
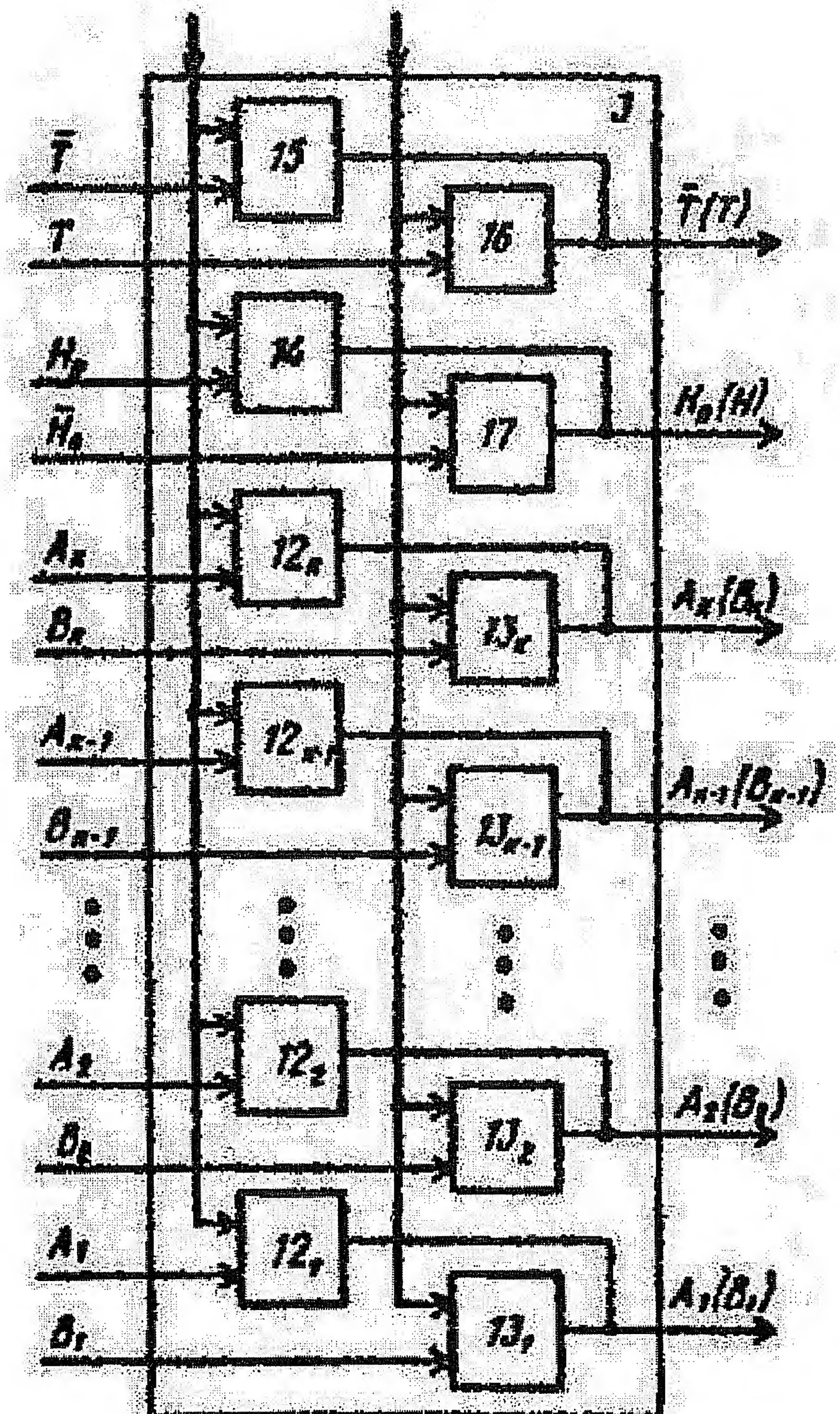


Fig. 2


3
15
16
14
17
$\bar{T}$
T
$\bar{T}(T)$
H_p
$\bar{H}_a$
$H_a(H)$
A_n
B_n
$A_n(B_n)$
A_{n-1}
B_{n-1}
$A_{n-1}(B_{n-1})$
A_2
B_2
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A_1
B_1
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12_1
13_1

Fig. 3

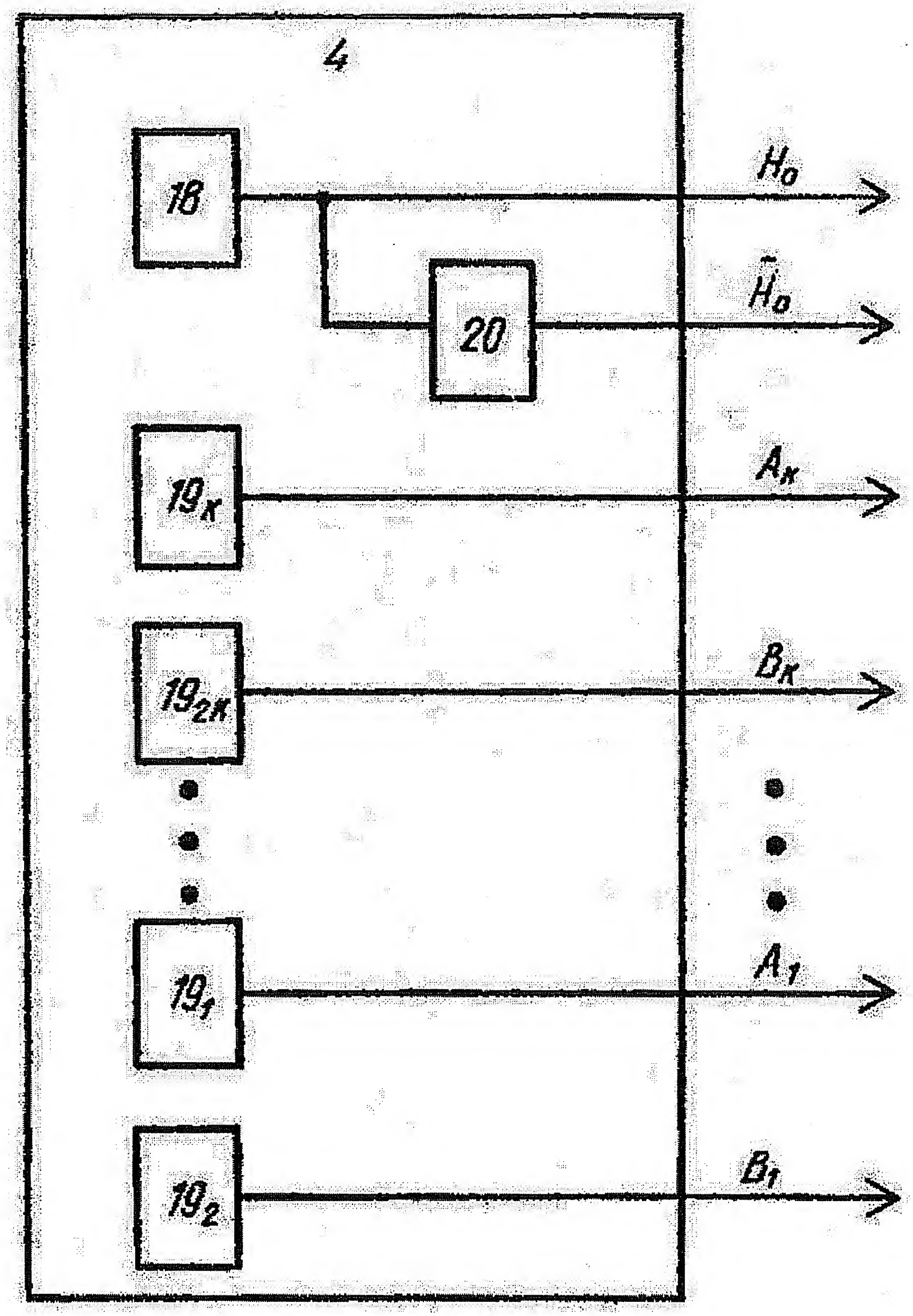

Fig. 4

(Printing details omitted)